REMARKS

The Office Action dated September 30, 2009, has been received and carefully noted. The above amendments to the claims, and the following remarks, are submitted as a full and complete response thereto.

In this Response, Figures 1-3 have been amended to overcome the objections to the drawings. Furthermore, claims 21, 32, and 38 have been amended to more particularly point out and distinctly claim the subject matter of the invention. Support for the above amendments is provided in Applicants' specification, at least, on page 3, line 18, to page 4, line 6. Accordingly, claims 21, 23-28, 30-33, 36-38, 40-42, and 46-47 are currently pending in the application, of which claims 21, 32, and 38 are independent claims. Applicants request entry of the above amendments because the above amendments place the figures and claims in better condition for issuance.

In view of the above amendments and the following remarks, Applicants respectfully request reconsideration and timely withdrawal of the pending rejections to the claims for the reasons discussed below.

Drawing Objections under 37 CFR 1.83(a)

The drawings were objected to under 37 CFR 1.83(a), alleging that the drawings fail to show a signal input to the "joint optimizer," shown in Figure 3 as described in the specification, page 8, lines 15-16. The Office Action alleged that since Figure 3 is a block diagram of a receiving portion of Figure 1, it is unclear how the "joint optimizer

74", as illustrated in Figure 3, is to be connected to existing component(s) of Figure 1 (*see* Office Action on pages 2-3).

Accordingly, Applicants submit a Replacement Sheet for Figure 1 to illustrate the arrangement of a "Prefilter and Feedback Filter Coefficients Calculator" between the "channel estimator 54" and the "prefilter 56," illustrating how the "joint optimizer 74," illustrated in Figure 3, is connected to the elements illustrated in Figure 1, and rendering the objection to the drawings moot. Applicants further note that the *single* block "joint optimizer" replaces the need for *multiple* "prefilter and feedback filter coefficients calculators," allowing optimization of a plurality of signal vectors from all receive antennas 22, and improving top performance of the multiple-input, multiple-output system.

The Office Action further objected to the drawings under 37 C.F.R. §1.83(a), because Applicants' specification allegedly failed to show support for the new drawing structure. In particular, the Office Action alleged that the inputs and outputs to and from the "joint optimizer 74" are allegedly not supported by Applicants' specification (*see* Office Action on pages 3-4). Applicants submit a Replacement Sheet for Figures 2 and 3 to more clearly illustrate the features recited in the pending claims, rendering the objections to the drawings moot. Applicants note that the number of inputs into the "joint optimizer 74" is 2x the number of receive antennas 22. Signal 53 is copied for illustrative purposes, *e.g.*, in Fig. 2, signal 53 from each receive antenna 22 is illustrated

as two inputs into the joint optimizer 74, however, signal 53 is actually a signal vector with elements from all receive antennas 22.

Applicants respectfully submit that the inputs and outputs to and from the "joint optimizer 74" are sufficiently described in Applicants' specification. For example, one of ordinary skill in the relevant art would have understood that the inputs to the "joint optimizer 74" are the outputs of the "channel estimators 54," as described in Applicants' specification, at least, in the equations described on page 15, line 18, page 16, line 3. Furthermore, one of ordinary skill in the relevant art would have understood that the inputs of the "joint optimizer 74" are also the two signals 53 from the "receive filters 52," as described in Applicants' specification, at least, in the equations described on page 15, lines 10-16, which describes the derivation of the "joint optimizer 74." Therefore, Applicants respectfully submit that one of ordinary skill in the relevant art would have understood that the features illustrated in Figures 2 and 3 for the inputs and outputs of the joint optimizer are sufficiently described in Applicants' specification.

No new matter has been added. Therefore, Applicants respectfully request consideration of the Replacement Sheets for Figures 1-3, and respectfully request that the objections to the drawings be withdrawn.

Claim Rejections under 35 U.S.C. §102(e)

The Office Action rejected claims 21, 23-26, 28, 30, 38, 40-42, 46, and 47 under 35 U.S.C. §102(e) as allegedly anticipated by Zangi, *et al.* (U.S. Patent No. 6,775,322)

("Zangi"). Applicants respectfully submit that the claims recite subject matter that is neither described nor suggested in Zangi.

Claim 21, upon which claims 23-28, 30-31, and 46-47 depend, recites an apparatus. The apparatus includes a signal filter configured to filter a signal from a signal receiver of a multiple-input, multiple-output system, and a signal estimator configured to estimate channel operations of the signal from the signal filter. The apparatus also includes a signal optimizer configured to generate optimized values for the signal from the signal filter, a prefilter configured to filter the signal from the signal filter using the generated optimized values for the signal, and a decision feedback sequence estimator configured to receive the generated optimized values. The decision feedback sequence estimator includes a summing element, a feedback filter, and a maximum likelihood sequence estimator. The summing element, the feedback filter, and the maximum likelihood sequence estimator are operatively connected to one another and further operatively connected to the prefilter. An interconnection of the prefilter, the feedback filter, the maximum likelihood sequence estimator, and the summing element in the apparatus is configured to permit concurrent interference and prefilter operations to be performed for a plurality of signals received by a plurality of signal receivers in the multiple-input, multiple-output system.

Claim 38, upon which claims 40-42 depend, recites an apparatus. The apparatus includes signal filtering means for filtering a signal from a signal receiver of a multiple-input, multiple-output system, and signal estimating means for estimating channel

operations of the signal from the signal filter means. The apparatus also includes signal optimizing means for generating optimized values for the signal from the signal filtering means, prefiltering means for filtering the signal from the signal filtering means using the generated optimized values for the signal and interference cancelling means for receiving the generated optimized values to perform concurrent interference and prefilter operations. The interference cancelling means includes pre-filtering means, summing means for summing inputs from the prefilter means, feedback filtering means for filtering optimized values and a summed output from the signal optimizing means and the summing means, respectively, and maximum likelihood sequence estimating means for generating maximum-likelihood values from the summing means. An interconnection of the pre-filtering means, the feedback filtering means, the maximum likelihood sequence estimating means, and the summing means in the apparatus is configured to permit the concurrent interference and prefilter operations to be performed for a plurality of signals received by a plurality of signal receivers in the multiple-input, multiple-output system.

Applicants respectfully submit that certain embodiments of the invention provide non-obvious advantages. Specifically, certain embodiments of the invention relate to a multiple-input, multiple-output (MIMO) communication system, whereby interference cancellation and equalization pre-filtering operations at a receiving station of the MIMO communication system are performed. Hence, the system includes a joint encoder, a MIMO transmission, and a MIMO receiver. Whereas, Zangi, Taylor, and Malkemes describe non-MIMO systems, *e.g.*, a single-input, single-output systems.

Hence, certain embodiments of the invention provide non-obvious advantages over the cited art references because the combination of receivers described in Zangi, Taylor, and Malkemes fail to provide joint encoding and MIMO transmission/reception.

As will be discussed below, Zangi fails to describe or suggest each and every element recited in claims 21, 23-26, 28, 30, 38, 40-42, 46, and 47, and therefore fails to provide the advantages and the features of the claims discussed above.

Zangi is directed to a method for computing a coefficient of a finite impulse response pre-filter applied prior to a decision algorithm in an equalizer having adjustable filter coefficients. Computations performed to compute the filter coefficients for a right half burst may be used to compute the prefilter for a left hand burst, reducing the number of computations. A square root-free algorithm may be used to solve the system of linear equations, reducing computational complexity (Zangi, col. 2, lines 8-39).

Applicants respectfully submit that Zangi fails to describe or suggest each and every element recited in claims 21 and 38. Specifically, Zangi fails to describe or suggest, at least, "a signal filter configured to filter a signal from a signal receiver of a multiple-input, multiple-output system" and "wherein an interconnection of the prefilter, the feedback filter, the maximum likelihood sequence estimator, and the summing element in the apparatus is configured to permit concurrent interference and prefilter operations to be performed for a plurality of signals received by a plurality of signal receivers in the multiple-input, multiple-output system," as recited in claim 21 (emphasis added), and similarly recited in claim 38.

Zangi fails to mention either feature associated with a multiple-input, multiple-output system. Zangi is specifically related to a system including a single transmitter and a single receiver.

Furthermore, contrary to the Office Action's allegations, Zangi also fails to describe "a decision feedback sequence estimator configured to receive the generated optimized values, wherein the decision feedback sequence estimator comprises a summing element, a feedback filter, and a maximum likelihood sequence estimator," as recited in claim 21 (emphasis added), and similarly recited in claim 38.

The Office Action grouped the feedback filter 104, the summer 106, and the decision algorithm 108 described in Zangi to allege that Zangi describes the "decision feedback sequence estimator" recited in the pending claims (*See* Office Action, pages 4-5, "circuits (104, 106, and 108) [are] considered as the claimed "decision feedback sequence estimator" to receive the coefficients (optimized values), note input to filter 104, *Response to Arguments*, on pages 12 and 13). However, a review of Zangi demonstrates that Zangi fails to describe or suggest each and every element recited in the pending claims.

Zangi explicitly describes an equalizer 100, which may be a decision feedback equalizer (DFE) or a decision feedback sequence estimation (DFSE) equalizer. Equalizer 100 includes an equalization filter 101, *a decision algorithm 108*, and a processor 120. Equalization filter 101 includes a prefilter 102, *a feedback filter 104*, and *a summer 106*. Processor 120 includes a channel estimator 122 and an adaptive algorithm 124 (Zangi,

Figures 1 and 3; col. 3, line 29, to col. 4, line 60). Thus, equalizer 100, which Zangi explicitly describes as a DFSE, includes a feedback filter 104, a summer 106, and a decision algorithm 108, *i.e.*, all three structural elements are contained within the DFSE 100 (*See* Zangi, Figure 3).

Zangi further explicitly describes that DFSE 100 includes the pre-filter 102, the channel estimator 122, and the adaptive algorithm 124, *i.e.*, the pre-filter 102, the channel estimator 122, and the adaptive algorithm 124 are also contained within the DFSE 100. Accordingly, one of ordinary skill in the relevant art would have understood that the DFSE 100 is not "configured to receive the generated optimized values" (emphasis added), rather, the optimized values are generated within the DFSE 100. DFSE 100 only receives the "received sequence, *r(k)*."

Applicants respectfully submit that the Office improperly re-grouped the elements of the DFSE 100, as described in Zangi, to exclude the processor 120, so that the "optimized values" generated within the adaptive algorithm 124 could be received within the newly grouped DFSE (only including the feedback filter 104, the summer 106, and the decision algorithm 108). As previously noted, Zangi explicitly describes that the DFSE includes the processor 120, the channel estimator 122, and the adaptive algorithm 124, and therefore the optimized values are generated within the DFSE 100, not received by the DFSE 100.

Accordingly, Zangi fails to describe or suggest, at least, "a decision feedback sequence estimator configured to receive the generated optimized values, wherein the

decision feedback sequence estimator comprises a summing element, a feedback filter, and a maximum likelihood sequence estimator," as recited in claim 21 (emphasis added), and similarly recited in claim 38.

Claims 23-26, 28, 30, and 46-47 depend from claim 21. Claims 40-42 depend from claim 38. Accordingly, claims 23-26, 28, 30, 40-42, and 46-47 should be allowable for at least their dependency upon an allowable base claim, and for the specific limitations recited therein.

Therefore, Applicants respectfully request withdrawal of the rejections of claims 21, 23-26, 28, 30, 38, 40-42, and 46-47 under 35 U.S.C. §103(a) and respectfully submit that claims 21 and 38, and the claims that depend therefrom, are now in condition for allowance.

Claim Rejections under 35 U.S.C. §103(a)

Claim 27

The Office Action rejected claim 27 under 35 U.S.C. §103(a) as being allegedly unpatentable over Zangi in view of Taylor, *et al.* (U.S. Publication No. 2002/0197987) ("Taylor"). Applicants respectfully submit that the claims recite subject matter that is neither described nor suggested in the combination of Zangi and Taylor.

Zangi was discussed above. Taylor is directed to a transparent data transmission for a wireless/cellular communication system. An analog signal from a modem or other source is converted at a remote station to a digital bit stream in accordance with a

memoryless compaction rule. The resultant bit stream is then transmitted through a transparent channel that includes a wireless cellular-telephone link. At the base station, that bit stream is transmitted over a public-switched-network span (Taylor, paragraphs [0003]-[0005]).

As previously noted, Zangi fails to describe or suggest each and every element recited in claim 21. Taylor fails to cure the deficiencies of Zangi. Specifically, Taylor fails to describe or suggest, at least, "a signal filter configured to filter a signal from a signal receiver of a multiple-input, multiple-output system" and "wherein an interconnection of the prefilter, the feedback filter, the maximum likelihood sequence estimator, and the summing element in the apparatus is configured to permit concurrent interference and prefilter operations to be performed for a plurality of signals received by a plurality of signal receivers in the multiple-input, multiple-output system," as recited in claim 21 (emphasis added). Accordingly, Zangi in view of Taylor fails to describe or suggest each and every element recited in claim 21.

Claim 27 depends from claim 21. Accordingly, claim 27 should be allowable for at least its dependency upon an allowable base claim, and for the specific limitations recited therein.

Therefore, Applicants respectfully request withdrawal of the rejection of claim 27 under 35 U.S.C. §103(a) and respectfully submit that claim 21, and the claims that depend therefrom, are now in condition for allowance.

Claims 31-33 and 36

The Office Action rejected claims 31-33 and 36 under 35 U.S.C. §103(a) as being allegedly unpatentable over Zangi in view of Malkemes, *et al.* (U.S. Publication No. 2002/0106040) ("Malkemes"). Applicants respectfully submit that the claims recite subject matter that is neither described nor suggested in the combination of Zangi and Malkemes.

Claim 32 recites a method. The method includes receiving a data vector at a receiving station of a multiple-input, multiple-output system, forming optimized feed forward filter parameters from the data vector, and forming optimized feedback filter parameters from the data vector. The method further includes transmitting the optimized feed forward filter parameters and the optimized feedback filter parameters to a decision feedback sequence estimator. The decision feedback sequence estimator includes a feedback filter. The method further includes applying the optimized feed forward filter parameters to a feed forward filter to define filter characteristics of the feed forward filter, applying the optimized feedback filter parameters to the feedback filter to define filter characteristics of the feedback filter, and simultaneously performing interference cancellation and pre-filtering operations on the data vector through operation of the feed forward and feedback filters. Receiving the data vector includes receiving a plurality of data vectors on a corresponding plurality of receiving chains at the receiving station of the multiple-input, multiple-output system.

As will be discussed below, the combination of Zangi and Malkemes fails to describe or suggest each and every element recited in claims 31-33 and 36, and therefore fails to provide the features of the claims discussed above.

Zangi was discussed above. Malkemes is directed to a method and apparatus for reducing multipath distortion in a wireless IAN system. A spatial diversity combiner includes a plurality of feed forward equalizers (FFEs), a decision feedback equalizer (DFE), and a tap control circuit. The plurality of FFEs receive spatially diverse replicas of an RF signal and optimally combine them. The DFE provides feedback for tap weight control and optimal equalization of the transmission channel. Symbol error is generated by a slicer circuit or by a maximum likelihood sequence estimation (MLSE) process (Malkemes, paragraph [0006]).

As previously noted, Zangi fails to describe or suggest each and every element recited in claim 21. Malkemes fails to cure the deficiencies of Zangi. Specifically, Malkemes fails to describe or suggest, at least, "a signal filter configured to filter a signal from a signal receiver of a multiple-input, multiple-output system" and "wherein an interconnection of the prefilter, the feedback filter, the maximum likelihood sequence estimator, and the summing element in the apparatus is configured to permit concurrent interference and prefilter operations to be performed for a plurality of signals received by a plurality of signal receivers in the multiple-input, multiple-output system," as recited in claim 21 (emphasis added).

Malkemes fails to mention either feature associated with a multiple-input, multiple-output system. Contrary to the Office Action's allegations, Malkemes is specifically related to a system including multiple receivers (input antennas 102) and a single transmitter (a single output) (*see* Malkemes, Figure 1). Accordingly, assuming *arguendo* that the description of Zangi and the description of Malkemes could be combined, the combination of Zangi and Malkemes fails to describe or suggest each and every element recited in claim 21.

For similar reasons discussed for claim 21, Applicants respectfully submit that the combination of Zangi and Malkemes fails to describe or suggest each and every element recited in claim 32. In particular, the combination of Zangi and Malkemes would fail to describe or suggest, at least, "receiving a data vector at a receiving station of a multiple-input, multiple-output system," "transmitting the optimized feed forward filter parameters and the optimized feedback filter parameters to a decision feedback sequence estimator," and "wherein receiving the data vector comprises receiving a plurality of data vectors on a corresponding plurality of receiving chains at the receiving station of the multiple-input, multiple-output system," as recited in claim 32 (emphasis added).

Claim 31 depends from claim 21. Claims 33 and 36 depend from claim 32. Accordingly, claims 31, 33, and 36 should be allowable for at least their dependency upon an allowable base claim, and for the specific limitations recited therein.

Therefore, Applicants respectfully request withdrawal of the rejections of claims 31-33 and 36 under 35 U.S.C. §103(a), and respectfully submit that claims 21 and 32, and the claims that depend therefrom, are now in condition for allowance.

Claim 37

The Office Action rejected claim 37 under 35 U.S.C. §103(a) as being allegedly unpatentable over Zangi in view of Malkemes, and further in view of Taylor. Applicants respectfully submit that the claims recite subject matter that is neither described nor suggested in the combination of Zangi, Malkemes, and Taylor.

Zangi, Malkemes, and Taylor were discussed above. As previously noted above, the combination of Zangi and Malkemes would fail to describe or suggest each and every element recited in claim 32. Taylor fails to cure the deficiencies of Zangi and Malkemes. Specifically, Taylor fails to describe or suggest, at least, "receiving a data vector at a receiving station of a multiple-input, multiple-output system," "transmitting the optimized feed forward filter parameters and the optimized feedback filter parameters to a decision feedback sequence estimator," and "wherein receiving the data vector comprises receiving a plurality of data vectors on a corresponding plurality of receiving chains at the receiving station of the multiple-input, multiple-output system," as recited in claim 32 (emphasis added). Accordingly, assuming *arguendo* that the descriptions of Zangi and Malkemes could be combined with the description of Taylor, the combination

of Zangi, Malkemes, and Taylor fails to describe or suggest each and every element recited in claim 32.

Claim 37 depends from claim 32. Accordingly, claim 37 should be allowable for at least its dependency upon an allowable base claim, and for the specific limitations recited therein.

Therefore, Applicants respectfully request withdrawal of the rejection of claim 37 under 35 U.S.C. §103(a) and respectfully submit that claim 32, and the claims that depend therefrom, are now in condition for allowance.

CONCLUSION

In conclusion, Applicants have amended Figures 1-3 to overcome the objections to the drawings and to more clearly illustrate the features of embodiments of the invention. Furthermore, Applicants respectfully submit that Zangi, Taylor, and Malkemes, whether taken individually or in combination, fail to describe or suggest each and every element feature recited in claims 21, 23-28, 30-34, 36-38, 40-42, and 46-47. The distinctions previously noted are more than sufficient to render the claimed invention unanticipated and non-obvious. It is therefore respectfully requested that all of claims 21, 23-28, 30-34, 36-38, 40-42, and 46-47 be allowed, and this present application be passed to issuance.

If for any reason the Examiner determines that the application is not now in condition for allowance, it is respectfully requested that the Examiner contact, by

telephone, Applicants' undersigned representative at the indicated telephone number to arrange for an interview to expedite the disposition of this application.

In the event this paper is not being timely filed, Applicants respectfully petition for an appropriate extension of time. Any fees for such an extension together with any additional fees may be charged to Counsel's Deposit Account 50-2222.

Respectfully submitted,

/Brad Y. Chin/

Brad Y. Chin
Attorney for Applicants
Registration No. 52,738

Customer No. 32294
SQUIRE, SANDERS & DEMPSEY LLP
14TH Floor
8000 Towers Crescent Drive
Vienna, Virginia 22182-6212
Telephone: 703-720-7800
Fax: 703-720-7802

BYC:dlh

Enclosure: Replacement Sheets, FIG. 1-3